

Claims

- [1] A field emission device comprising:
a cathode portion having a substrate, a cathode electrode formed on the substrate, and a field emitter connected to the cathode electrode;
a field emission-suppressing gate portion formed on the cathode portion around the field emitter and surrounding the field emitter; and
a field emission-inducing gate portion having a metal mesh with at least one penetrating hole, and a dielectric layer formed on at least a part of the metal mesh,
wherein the field emission-suppressing gate portion suppresses electrons from being emitted from the field emitter, and the field emission-inducing gate portion induces electrons to be emitted from the field emitter.
- [2] The field emission device according to claim 1, wherein the dielectric layer of the field emission-inducing gate portion is formed on an entire surface or a portion of the surface of the metal mesh.
- [3] The field emission device according to claim 1, wherein a size of the penetrating hole of the field emission-inducing gate portion is not greater than one time to three times a thickness sum of the metal mesh and the dielectric layer.
- [4] The field emission device according to claim 1, wherein the penetrating hole of the metal mesh has at least one inclined inner wall.
- [5] The field emission device according to claim 4, wherein the dielectric layer covers the inclined inner wall of the penetrating hole.
- [6] The field emission device according to claim 1, wherein the field emission-suppressing gate portion is electrically insulated from the field emission-inducing gate portion, and has an insulator with a field emission-suppressing gate opening therein, and a field emission-inducing gate electrode formed on the insulator.
- [7] The field emission device according to claim 6, wherein a size of the field emission-suppressing gate opening is one time to twenty times a thickness of the insulator.
- [8] The field emission device according to claim 4, wherein the inner wall of the metal mesh includes a protrusion having at least two inclined angles.
- [9] The field emission device according to claim 1, wherein the metal mesh of the field emission-inducing gate portion is a metal plate formed of one of aluminum, iron, copper and nickel, or an alloy plate containing at least one of stainless steel, invar and kovar.
- [10] The field emission device according to claim 1, wherein the field emission-suppressing gate portion is divided into plural ones per unit pixel.

- [11] The field emission device according to claim 1, wherein a size of the penetrating hole of the metal mesh in the cathode portion is larger than that in the anode portion.
- [12] The field emission device according to claim 1, wherein the field emitter is formed of a thin or thick film formed of one of diamond, diamond like carbon, carbon nanotube, and carbon nanofiber.
- [13] The field emission device according to claim 12, wherein the field emitter is formed by directly growing any one of diamond, diamond like carbon, carbon nanotube, and carbon nanofiber on the cathode electrode using a catalytic metal.
- [14] The field emission device according to claim 12, wherein the field emitter is formed by printing a paste containing any one of powder type diamond, diamond like carbon, carbon nanotube and carbon nanofiber.
- [15] A field emission display device comprising:
a cathode portion including cathode electrodes and field emission-suppressing gate electrodes arranged in a stripe form to allow matrix addressing to be carried out and insulated from each other on a substrate, and pixels defined by the electrodes, each pixel having a field emitter connected to the cathode electrode;
a field emission-suppressing gate portion having an insulator with a gate opening in the field emission-suppressing gate of the cathode portion formed on a region around the field emitter in the form of surrounding the field emitter;
a field emission-inducing gate portion having a metal mesh with at least one penetrating hole allowing electrons emitted from the field emitter to pass therethrough, and a dielectric layer formed on at least a part of the metal mesh;
and
an anode portion having an anode electrode and a phosphor connected to the anode electrode,
wherein the field emission-suppressing gate portion suppresses electrons from being emitted from the field emitter, and the field emission-inducing gate portion induces electrons to be emitted from the field emitter so that the electrons emitted from the field emitter collide with the phosphor via the penetrating hole.
- [16] The field emission display device according to claim 15, wherein the cathode portion, the field emission-suppressing gate portion, the field emission-inducing gate portion, and the anode portion are vacuum-packaged such that the field emitter of the cathode portion is opposed to the anode electrode of the anode portion via a field emission-suppressing gate opening and the penetrating hole.
- [17] The field emission display device according to claim 16, wherein a constant direct current voltage is applied to the field emission-inducing gate portion to induce electron emission from the field emitter of the cathode portion, and a scan

signal having a negative voltage is input to the field emission-suppressing gate portion and a data signal having a positive or negative voltage is input to the cathode portion to display an image.

- [18] The field emission display device according to claim 17, wherein a pulse amplitude or a pulse width of the data signal is modulated to represent a gray scale.
- [19] The field emission display device according to claim 15, wherein the anode portion is composed of a transparent substrate, transparent electrodes formed on the transparent substrate, phosphors of red (R), green (G) and blue (B) colors formed on a predetermined region of each transparent electrode, and a black matrix formed between the phosphors.
- [20] The field emission display device according to claim 15, wherein the field emission-inducing gate portion is formed on a separate substrate.
- [21] The field emission display device according to claim 15, wherein the cathode portion, the field emission-suppressing gate portion, and the field emission-inducing gate portion are opposed to the anode portion using a spacer as a support.
- [22] The field emission display device according to claim 15, wherein the dielectric layer is formed on an entire surface or a part of the surface of the metal mesh.
- [23] The field emission display device according to claim 15, wherein a size of the field emission-suppressing gate opening is equal to or smaller than one time to twenty times a thickness of the insulator layer.
- [24] The field emission display device according to claim 15, wherein the penetrating hole of the metal mesh has at least one inclined inner wall.